

Dynamic Design: The Cleanroom

The Cleaning Room

STUDENT TEXT

In order to keep the cleanroom certified at class 10, all equipment taken into the room needs to be cleaned before entering. During the filming of the *Cleanroom Technology: NASA Genesis Mission* video, all cameras, tripods, battery and film packs had to be cleaned. This took place in the De-Integration room, which is the first room as one enters the cleanroom facility. Getting things clean is not limited to entering the Genesis cleanroom.

Washing Dishes

Do you have an electric dishwasher at your home or does your family wash dishes by hand? In 1991 only 45% of homes in the United States had an electric dishwasher. People who have machines to do work for them sometimes rely on them so that when the appliance breaks, there is an impact. There was a family whose dishwasher stopped working. When the service person came to look at it, he determined that the switch needed to be replaced. Unfortunately he did not have one in the truck. So the switch had to be ordered. This meant that the family had to wash dishes by hand for a week. Washing the dishes by hand had become a routine. Every night the sink would be filled with hot water and dish detergent. Dishes were then scrubbed by hand, rinsed, dried and then put away. There is nothing unusual about this sequence of events. Most people have gone through this process. Is there a better way to wash dishes? The contamination control group at Johnson Space Center in Houston, Texas has developed a way to wash tools and parts that were used in the assembly of the collector array.



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The Cleaning Process in the Genesis Cleaning Room

The Genesis Cleaning Lab has an ultra pure water heater. Ultra pure water is used so that the water itself does not contaminate the sample. The water is generally heated to about 65 degrees Celsius. This can be hot to the skin. The workers typically use double gloves. This keeps the inner gloves relatively clean and the outer layer can be changed easily. View a short [video](#) of this procedure.



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On the wash table ultra pure water is poured into two tubs. One tub has two or three drops of liquid detergent and the second contains just rinse water. The liquid detergent is used to break the surface tension of the contamination on the object being washed. According to Contamination Control Lead Scientist Eileen Stansbery, "The key to washing and getting something very clean is to never let it get dry when soap is on it." It is important that the person washing knows what is in the tub so that the items do not get mixed up. The Genesis scientists have a recipe for cleaning items. The first side gets rubbed ten times with a clean rag, and then the second side gets rubbed ten times. The item is then placed into the rinse water. Once all of the items are washed, the process is then repeated using the other side of the rag. A third washing is completed after the tubs have been rinsed and refilled with water this time using a clean rag.

Once the samples have been cleaned three times, they are put in a water cascade tank. The cascade tank is a tank inside a tank. Water continuously flows into the interior tank. Water then overflows from the interior to the exterior tank. The cascade tank allows a continuous flow of clean water around the samples. Think about the difference between a shower and a bath. In a bath you are surrounded by water that starts out clean, but becomes more and more dirty as you wash. In a shower clean water is constantly hitting your body-removing dirt that you have scrubbed and rinsing it down the drain. In the cascade tank, gaseous nitrogen is used to maintain the flow of the water. The water is pushed up to keep bubbles from clinging to the materials. If bubbles cling to the sample, no cleaning action can occur. Scientists also move the samples to loosen the bubbles so they do not cling to the sample. The cascade tanks in the Genesis cleanroom were made specifically for this mission. A large cascade tank is used for cleaning the gap shield, array frame and canister. A smaller tank is used for cleaning tools and parts.

Verifying Clean

The scientists employ two methods to verify that these samples are in fact clean. A binocular microscope is used for visual inspection. Everything that is cleaned is observed to verify that all the particles have been removed. A liquid particle counter is also used to verify cleanliness. The samples are rinsed with water that is placed in a beaker. The beaker is put through a laser particle counter which indicates the number and size of particles in the rinse water.

The techniques mentioned here might seem to be quite tedious. The attention to detail described here is necessary to maintain a level of cleanliness required to assemble the collector arrays so that they are as clean as possible prior to the launch of the spacecraft. This will ensure that the samples that are returned to Earth reflect accurate abundances of solar wind.



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